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(54) A system for control and management of a fleet of vehicles

(57) A system for control and management of a fleet of vehicles comprising an equipment to be mounted on-board of the vehicle, adapted to collect all data furnished by a set of sensors either provided on said vehicle or conveniently arranged to these purposes (running and diagnostic data), as well as all data transmitted by the ground (garage) station to all exiting vehicles, and a ground equipment to be mounted at the vehicle parking garage to transmit ground data to the vehicles and receive data collected during the service therefrom, wherein

- said on-board equipment comprises a logic unit including a controller block (14), a central box (15) for collecting the operation parameters and central box (16) for collecting the running parameters, as well as a transceiver unit comprised of a complete microprocessor system, adapted to handle protocols, codes and cryptographs of any kind; and in that

- said ground equipment comprises a server apparatus with which multiple control ports (A, B, C, D) cooperate, connected thereto by means of a data network.

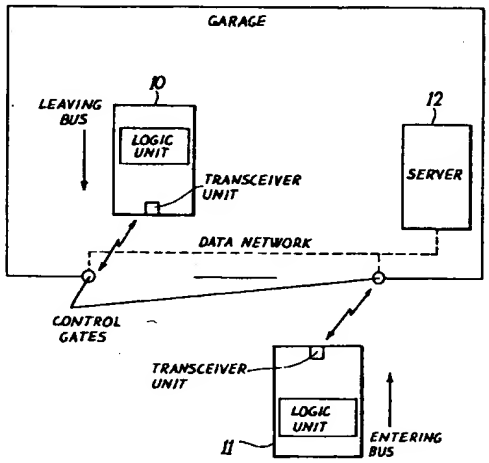


FIG. 1

EP 0 708 427 A2

Description

This invention relates to a system for controlling and managing a fleet of motor vehicles and, more particularly, it concerns a novel information collecting system adapted to integrate all necessary parameters for controlling and managing a fleet of motor vehicles for transport of passengers in urban and extra-urban areas, as well as for displaying this information to the public.

This project is aimed at collecting, analyzing and sorting all typical operation parameters of the concerned motor vehicles, all service managing parameters and any other productivity related parameters.

The instruments implemented in stable steady state conditions will form an analytical base adapted to continuously furnish in real time all necessary data upon which the daily control of the whole fleet can be based.

In recent years, various systems have already been developed for controlling and managing fleets of motor vehicles used for urban and extra-urban transport of passengers. Such systems, however, even if they are more or less flexible and sophisticated, are substantially related only to the S.A.E. (Systema di Assistenza all'Esercizio = System for Operation Assistence) System and to transmission of particular alarms concerning the operation of the vehicle. These applications are substantially concerned with checking that the performance time table be vehicleefully respected, by analyzing any variations with respect to the predetermined passage times, any anomalies and any obstacles in the various runs as well as any spoken communications.

At the present state of the art, therefore, no integrated and flexible system exists to enable the operation, the management, the diagnosis and the maintainance services of a fleet of motor vehicles to be effectively organized, unless different apparatuses are installed onboard of the vehicles, each of which intended to solve a particular problem. Even in this case, anyway, comprehensive expenses should be incurred without any justification for the implementation of the project as a whole, also because up-to-now there is no unique and standard management method for connecting together all the on-board apparatuses and for collecting data therefrom.

Furthermore, the display in real time of the information addressed to the users is performed by means of expensive radio location systems acting on the whole territory (with all related equipment, such as radio bridges and relay stations) or GPS (Global Position System) equipment.

The system according to this invention, on the other side, solves problems that had been not even tackled by the prior art.

It is a specific object of this invention to provide a system comprising various apparatuses installed onboard of vehicles for overviewing and costantly controlling the operation parameters of all installed, both main and auxiliary devices (engine, course indicators, obliteration devices, gear-box operators, contamination indicators, and so on) and, upon utilization of all collected information, for vehiclerying out an information service in real time for the users. All collected data items are automatically transmitted, on returning back to the garage, to a ground based system which handles and anlyzes them in real time.

From a ground based, information handling view point, a system is provided, based upon a geographical network, for detecting the passage of the vehicles at the bus-stops and for processing this information in order to compute the waiting times at the other bus-stops along the run course.

The system according to this invention enables the vehicles to be managed according to real criteria of preventive maintainance and with a vehicleefully timed frequency so as to prevent severe failures from occurring as well as to reduce the inactivity times of the vehicles for maintainance purposes; this invention additionally enables an informative system to be realized, based upon statistical data generated in the field and integrated (amended) with any real time data coming from the territory.

The design of such a system requires the development of inventive technological solutions in respect of:

- the integration of all on-board apparatuses by means of a special network for interconnecting all involved apparatuses, purposedly designed in order to keep the hostile environment where it operates into account;
- the bilateral transmission between the vehicles and the ground station;
- the transmission of all data stored in the on-board computer to the ground station;
- the automatic transmission of all data concerning the work shifts to the on-board computer;
- the provision of display apparatuses at the bus-stops, integrated by a short range pick up system, that utilizes all apparatuses already installed on-board;
- the provision of a geographic communications network for connection of all display apparatuses;
- the provision of an informatics system adapted to up-date the data in real time.

Advantageous effects resulting from adoption of a system according to this invention are related to noticeably reducing the environmental pollution, increasing the throuput, improving the relationships with the users and with the operation personnel, optimizing the services.

Furthermore, when a constant and systematic control is applied to the behaviour of the utilization/efficiency of all process parameters (namely resources, investments, etc.), of all related services (namely maintainance, logistics, etc.) as well as of the service transparency, it is possible to improve and to substain the work

of the operating personnel thereby increasing its efficiency and increasing the appreciation of the public service by the users.

As above mentioned, the system according to this invention is adapted to receive, to evaluate and to process a large number of data items, including not only all data relating to the controlled vehicle, but also all data concerning the route followed and the frequency of use of the concerned line by the passengers, together with any data concerning the diagnostics of the vehicle itself.

The objects which can be aimed at by adoption of such a system can be divided into two main categories: external objects and internal objects.

The internal objects are mainly as follows:

a) realization of a continuous type of diagnostics of the various vehicle assemblies and, therefore, the possibility to adopt a predictive and preventive maintainance regime, aimed at reducing the number of unoperative vehicles due to failures and consequently the net number of vehicles required to vehiclery out the requested service;
b) improvement of the field and garage workshop organization, by immediate and up-dated knowledge of all intervents to be vehicleried out;
c) reliability analysis of the various vehicle assemblies and, consequently, better organization of the maintainance intervents, as well as the possibility to obtain that any unreliable apparatus be substituted by the manufacturer companies, thereby additionally reducing the number of unoperative vehicles subjected to maintainance intervents.

The main external object, namely all objects related to the users, are as follows:

i) higher regularity of service, that can be obtained by means of the following possibilities offered by this system:

- statistical evaluation of the running times of the individual lengths of the route and consequently the possibility to adopt provisions connected to the way conditions (such as adoption of different traffic rules, the institution of reserved lanes, reserved roads, changement of the line routes, etc.) at all those points where the vehicles are more noticeably slowed down;
- decrease of the stop times of the vehicles in line due to failures and related inefficiencies, thanks to the above mentioned introduction of the predictive maintainance operation;

ii) Automatic management of the available resources. Since it is possible to monitor the behaviour of the vehicles, both in respect of the run times and in respect of the frequency of use of the system by passengers and since it is also possible to check all changes occurring over the time, not only during the various days of the week (working days, Saturday and Sunday days, etc.), and also during the months and in the various seasons, it will be possible to match the service furnished to the demands, thereby realizing at the same time a certain optimization of use of the available vehicles.

iii) Information to the user within the vehicles. Since the progressive positions of the vehicles along their routes are known in real time and also the succession of the stops therealong is known, it is possible to annunciate the next stop within the vehicle itself in completely automatic manner, without diverting the attention of the driver from his job.

iv) Implementation of a central control for informing the waiting users. Since the position of each vehicle along the route is known in real time, it is possible to control the various lines from a single station and then to communicate the forecast waiting times for the vehicles both at the bus-stops and to the on-board passengers. Furthermore, the knowledge in real time of the carried load will enable the transport capability to be timely matched to the requirements.

v) Noticeable reduction of the environment pollution. Since the anti-pollution devices of the various vehicles are continuously tested, it is possible to tempestively intervene as soon as these devices do not correctly operate, thereby drastically reducing the environmental atmosphere pollution.

In addition to all above external objects, a further and perhaps most important object is to be considered, namely to reach, by fulfilling all above mentioned requirements, a high efficiency and effectiveness in providing the requested services and thereby to establish the grounds to obtain a modification of the modal distribution (elimination of redundant parallel lines) so as to induce the user to using to ever increasing extent the public transport means.

This modification of the modal distribution reduces on the whole the number of vehicle in use and this reduction, when added to the reduction of the environmetal pollution generated by the vehicles, as above noted, entails a further reduction of the global pollution level generated by the whole service within the urban area thereby covered.

Further details and advantages of this invention will be evident from the following specification by referring to the enclosed drawings wherein the preferred embodiment is shown by way of illustration and not by way of limitation.

In the drawings:

Figure 1 shows a conceptual diagram of the system according to this invention;
Figure 2 shows a diagram of the ground station;
Figures3A and 3B combined together show a block diagram of the on-board system;

Figure 4 shows a block diagram of the transceiver unit;

Figure 5 shows a block diagram of the ground equipment.

By referring now to the drawings, it can be seen that the system comprises (A) an equipment on-board of the vehicle and (B) a ground equipment for providing information to the user.

The equipment on-board of the vehicle is adapted to collect all data furnished by a set of sensors either provided on said vehicle or conveniently arranged to these purposes (running and diagnostic data). This equipment is also adapted to collect all data transmitted by the ground (garage) station to all exiting vehicles.

In Figure 1, a bus 10 exiting from and a bus 11 entering into a garage are shown, each provided with an on-board equipment with a logic unit and a transceiver unit associated therewith, as well as a ground equipment 12 which communicates through a data network with a plurality of control ports for communicating with the entering and with the exiting buses. Further details of the ground equipment can be derived from Figure 2, which shows a computer server assembly linked to four control ports A, B, C and D through a data network.

By referring now to Figures 3A, 3B, the on-board system or equipment comprises the following main macro blocks, being it understood that some functions can be distributed to different blocks or portions of the equipment, for instance the weighing and counting function of the passenger:

a logic unit 13 that comprises a controller block 14, a central box 15 for collecting the operation parameters and a central box 16 for collecting the running parameters.

Said controller block 14 is a block by which the whole pick-up system is managed. It collects data coming from the various peripheral units, then it organizes and stores all data. Furthermore, it communicates with the transceiver system to get access to the Local Area Network (L.A.N.) of the garage. Lastly, it receives all data relating to the operation parameters and transmits all data collected along its route.

The central unit 5 that collects the operation parameters converts all analogue data furnished by the various sensors and communicates them to said controller block 14. It specifically deals with the signals concerning the operation of the engine as well as the operation of the various apparatuses, such as the temperatures, the pressures, etc.

The central unit 16 that collects the running parameters operates nearly in the same manner as the first central unit 15 that collects the operation parameters, but it deals with all signals concerning the operation of the transport system, such as the number of kilometers and the running times, the speeds, the fuel consumption, etc.

The following blocks are not explicitly shown as autonomous blocks, but they are anyway included in the global structure of the on-board equipment.

A passenger weighing device having a physical passenger counting system logically associated thereto, possibly implemented by means of a cell system. For weighing purposes, a pneumatic suspension device is arranged between the vehicle body and the wheel axes. When suitable and known pressure sensors are used, this device collects instant-by-instant all data concerning the total weight of the vehicle and implements a specific filter and average algorithm, correlated with the route. In addition, it transmits the information representing the number of passengers on-board of the vehicle to the controller block.

An interface for the external line indicator, comprising a peripheral unit designed with the aim to read the line indicator board carried by each bus, by picking up the line number and its description for transmission to the above said controller module. If desired, it is possible for this module to automatically set up the new data upon the indicator, without any personnel intervention.

A further central box provided in the on-board equipment is the particulate filter control central box. This central box performs the function to manage the correct operation of the particulate filter (catalytic muffler) and to indicate, by means of various alarm levels, the incorrect operation of the system or the need of maintainance intervents.

A further interface is provided for annunciating the next stop by optical or acoustical means. This central box enables the data concerning the route followed by the vehicle to be stored and to repeat at the various bus-stops all messages relating to them.

The data exchange takes place by means of a transceiver unit detailedly shown in Figure 4, which comprises a complete microprocessor system, adapted to handle protocols, codes and cryptographies of any kind. It can be observed that, in effect, it includes an Central Processing Unit (CPU), connected to a RAM/EPROM memory and to a ROM memory, coupled to a radio transceiver apparatus with related antenna. Said transceiver unit is of course installed in front position on each vehicle and it is connected to the on-board system by means of a special line.

In order to furnish further, but, anyway, not exhaustive and not limitative details, the data picked up by the on-board equipment are as follows:

a) Vehicle identification data

1. day of the year on which the data are picked up,
2. running number of the vehicle,
3. number of the line on which the vehicle operates,
4. number of the "train" identifying the service,
5. registration number of the driver,
6. work shift number of the driver.

b) Parameters, Quantities and Members to be monitored

1. charge level of the batteries,
2. charging regularity of the alternator,
3. oil pressure in the engine,
4. oil temperatur in the gear-box,
5. cooling fluid temperature,
6. cooling fluid level,
7. oil level within the hydrofan,
8. hydrofan power (I and II speed),
9. air pressure in front brake plenum,
10. air pressure in rear brake plenum,
11. fuel level,
12. speed,
13. low oil level within the hydrodrive box,
14. low oil level in subsidiary oil tank,
15. solenoid valve supply for the automatic lubrification plant,
16. low oil level within the brake circuit,
17. low air pressure within the suspension plenum,
18. low grease level within the related tank,
19. max/min oil level within the engine oil sump,
20. braking efficiency (deceleration),
21. braking efficiency: start of hydraulic braking (retarder),
22. engine r.p.m.,
23. lack of air draft within the gasoil passages, filter condition,
24. engine room temperature,
25. status control of the shift unlock pushbutton,
26. efficiency of the heating plant of the driver cab (defroster),
27. efficiency of the inlet doors,
28. service air,
29. failure push-botton,
30. efficiency of the ticket stamping machine (indicated time, tape condition, printer),
31. pneumatic suspension efficiency,
32. level valves condition,
33. accelerator control,
34. pneumatic plant efficiency (pressure in the pressure-switches connected with the tanks compared to the r.p.m. of the engine),
35. efficiency of the particulate filter (amount of built-up particulates, recovery time, faulty filter indicator),
36. shorter recovery time as on-off cycle duration of the indicator lamp.

c) On-board lamps to be monitored Electric motors

1. defroster air fan motor,

Indicators

1. open door indicator,
2. parking brake,
3. optional stop request,
4. low oil level in brake oil tank,
5. low air pressure,
6. axle 1 suspension,
7. axle 2 suspension,
8. axle 2 suspension Dx,
9. charging efficiency of the alternator,
10. low oil lever in the hydrodrive tank.

Lamps

1. internal corridor lamps,
2. optional stop request,
3. line indicator boards,
4. position lights,
5. lower beams,
6. upper beams,
7. stop lights,
8. turn indicators,
9. number plate lights,
10. backing lamp.

d) Running parameters

Times

1. starting time of the service,
2. ending time of the service,
3. duration time of each travel,
4. duration time of each stroke between two bus-stops,
5. duration time of each stroke between two nodes,
6. duration time of each stroke in a reserved lane,
7. duration time of any strokes run out-of-service,
8. cumulative travel time of the vehicle,
9. duration time of all stops at the line ends with running engine,
10. duration time of all stops at the line ends with standstill engine,
11. duration time of dwells in garage,
12. stop duration times.

Distances

1. cumulative number of kilometers run in-line,
2. cumulative number of kilometers rum outline.

Events

1. number of travels in-line,
2. number of travels out-line,
3. number of free dwells in garage,
4. number of free dwells at the line ends,
5. number of stops,
6. number of starting actions of the engine,
7. number of engine stops.

Loads

1. number of people present on-board during each stroke between stops,
2. number of embussing and dismounting people at each bus stop,
3. number of stamped tickets during each stroke between two bus stops.

Again referring to the transceiver unit construction of Figure 4, the on-board microprocessor (CPU) implements a program contained within the ROM memory, adapted to establish a communication session with the groun based station. This communication session permits the packet exchange between the two stations and said packets can be utilized both within the transceiver unit itself and in information exchanges with peripheral equipments coupled to said transceiver unit. Besides said ROM memory, also a RAM memory and an EPROM memory are provided to configurate the transceiver unit itself, according to the application type and to the coupled device kind.

The transmission from the ground station is active and the transmission from the transceiver is passive. No power is utilized on said transceiver unit for generating the radio frequency carrier for retransmission to the ground station. The oncoming carrier from the ground station is simply reflected.

The following further details are furnished only by way of illustration and not by way of limitation. The transmission protocol is proprietary. The transceiver unit is "slave" with respect of the ground station: the transceiver unit is normally in quiescent condition. When it is reached by a carrier at a frequency of 300 Mhz, it is awaked with a re-starting time of 100-150 msec and becomes ready to receive messages from the ground station. These messages can be of so-called personal kind, that is messages addressed to an individual transceiver unit; or they can be addressed to all transceiver units reached by the carrier signal. In this case, a reply can be contemporaneously transmitted by more than one transceiver units and, for this reason, a collision solving procedure is activated in order to individually recognize all of the transceiver units involved within the antenna range. The transmission protocol, similar to ADLC, is adapted to assure the correctness and the succession order of the transmitted packets.

As above mentioned and referring now to Figure 5, the ground station equipment is adapted to recognize the vehicles and to collect all data stored during the service. This equipment is also adapted to transmit data from the ground station to the various vehicles. It can be observed in Figure 2 that the macroblocks of the equipment comprise control ports and a server. Said control ports, such as A, B, C and D, are effectively data picking up members and comprise a P.C. type microprocessor, capable to be interfaced to any data network and to any remote computer. These ports are installed at the fuel supply apparatuses and/or at the garage inlet gates and have a directional antenna directed to the front face of the vehicle which is intended to be controlled.

The server apparatus as a matter of fact can be a Personal Computer.

The antenna type depends on the specific application. For remote control of moving vehicles, high directionality, double antenna system will be used, such as a plural component YAGI system.

By referring again to Figure 5, it can be observed that the antenna is coupled to a front end block 17, designed to amplify the output signal so as to raise it to the necessary level for transmission. In the opposite way, it separates the return signal, amplifies it and converts it to a lower frequency suitable for the intermediate frequency stage of the receiver. Receiver 18 demodulates the received signal and prepares it for subsequent digital processing. In addition, it tracks the frequency of the signal by acting upon the local oscillator 19 by means of an AFC (Automatic Frequency Control) signal. Said local oscillator 19 supplies the necessary signals for transmission and demodulation to the two above mentioned blocks.

A Digital Signal Processor (DSP) 20 implements some particular algorithms for signal recovery in hard propagation conditions, reflections, etc.

The core of this equipment is an Industrial P.C. 21. It includes a microprocessor board (for instance a 12 Mhz CPU 286, provided with a 1 M byte RAM memory), two serial ports 22, 23, a parallel port 24, a controller with FDD 25 and HDD 26, a graphics card VGA 27, a port for a keypad 28, a port for a mouse 29. The above mentioned P.C. is provided with a 8-bit Ethernet card 30, having a 50 ohm Thin Ethernet output and a Transceiver output, a 1.44 M Floppy Disc driver as well as a Hard Disc with a capacity of at least 40 M bytes.

The data exchange between the P.C. and the radio frequency section is carried out by means of a bus expansion card.

As it well be easily understood by those skilled in the art, various Input/Output (I/O) devices can be used for external world control (optoinsulators, relais, sensors and actuators of various kinds).

The above described system is characterized by some peculiarities, such as:

- noise immunity: also in neighbourhood of electric tranway lines or of workshops with electric welding apparatuses and other generic electric equipment,
- transmission reliability and rapidity: the transceiver unit can utilize complex protocols for assuring an absolute data integrity. In addition, the transmission can be effected with the vehicle in rapid movement within the range covered by the antenna. Communications can be made also with vehicles moving at a 60 Km/hour speed;
- installation ease: the transceiver unit is extremely small and light and effectively is manufactured as a

small box suitable for attachment to the windshield.

The preferred embodiment of this invention has been hereinbefore explained, but it should be understood that those skilled in the art can made variations and changes therein without departing from the scope of this invention.

Claims

1. A system for control and management of a fleet of vehicles comprising an equipment to be mounted on-board of the vehicle, adapted to collect all data furnished by a set of sensors either provided on said vehicle or conveniently arranged to these purposes (running and diagnostic data), as well as all data transmitted by the ground (garage) station to all exiting vehicles, and a ground equipment to be mounted at the vehicle parking garage to transmit ground data to the vehicles and receive data collected during the service therefrom,
   characterized in that
   - said on-board equipment comprises a logic unit including a controller block (14), a central box (15) for collecting the operation parameters and central box (16) for collecting the running parameters, as well as a transceiver unit comprised of a complete microprocessor system, adapted to handle protocols, codes and cryptographs of any kind; and in that
   - said ground equipment comprises a server apparatus with which multiple control ports (A, B, C, D) cooperate, connected thereto by means of a data network.

2. A control and management system according to claim 1, characterized in that said controller block (14) included in the on-board logic unit is based upon a microprocessor and it collects, organizes and stores data coming from the various peripheral units, communicates with the transceiver unit to get access to the Local Area Network of the garage, receives all data relating to the operation parameters and transmits all data collected during its route.

3. A control and management system according to claims 1 and 2, characterized in that said central box (15) for collecting the operation parameter data cooperates with multiple sensors designed to pick-up the operation parameters of the engine and of the various members of the vehicle (temperature, pressures, etc.) and it receives the signals generated therefrom and transmits them to said controller block (14).

4. A control and management system according to claims 1-3, characterized in that said central box (16) for collecting the running parameter data operates in analogous manner as said central box (15) for collecting the operation parameter data, but it specifically deals with all signals concerning the operation of the transport system and the implementation of some functions (number of kilometers, running times, speed, fuel consumption, communications to passengers, operation of the ticket stamping apparatus, etc.).

5. A control and management system according to claim 1, characterized in that said transceiver unit is mounted in front position on each vehicle and it is connected to the on-board equipment by means of a specialized line.

6. A control and management system according to claim 1, characterized in that it further comprises a passenger weighing apparatus including a pneumatic suspension device arranged between the vehicle body and the wheel axes thereof, which comprises pressure sensors to collect instant-by-instant all data concerning the total weight of the vehicle and means to evaluate such data based upon a specific algorithm correlated with the route and to communicate the number of passengers on-board of the vehicle to said controller block (14).

7. A control and management system according to claim 6, characterized in that said passenger weighing apparatus cooperates with means adapted to count the embussing and dismounting passengers.

8. A control and management system according to claim 1, characterized in that it further comprises an interface for the external line indicator, in order to read the line number and its description as entered by the service personnel from said indicator and to transmit the read data to said controller block (14).

9. A control and management system according to claim 8, characterized in that said interface with the external line indicator is adapted to automatically set-up new data upon the indicator without personnel intervention.

10. A control and management system according to claim 1, characterized in that said control ports (A, B, C, D) include a microprocessor system of P.C. type adapted to be interfaced with any data network and with any remote computer, said control ports being arranged near the fuel supply apparatuses and/or at the inlet gates of the garage and being provided with a directional antenna which is oriented toward the front side of a vehicle to be controlled.

11. A control and management system according to claim 1, characterized in that the radio frequency block of said ground equipment comprise a front end block (17) designed to amplify the output signal so as to raise it to the necessary level for transmission, to separate the return signal, to amplify it and to convert it to a lower frequency suitable for the intermediate frequency stage of the receiver; a receiver block (18) to demodulate the received signal and to prepare it for subsequent digital processing, as well as to track the frequency of the signal by acting upon a local oscillator (19), by means of an automatic frequency control signal, said local oscillator providing both above quoted blocks with the necessary signals for transmission and demodulation.

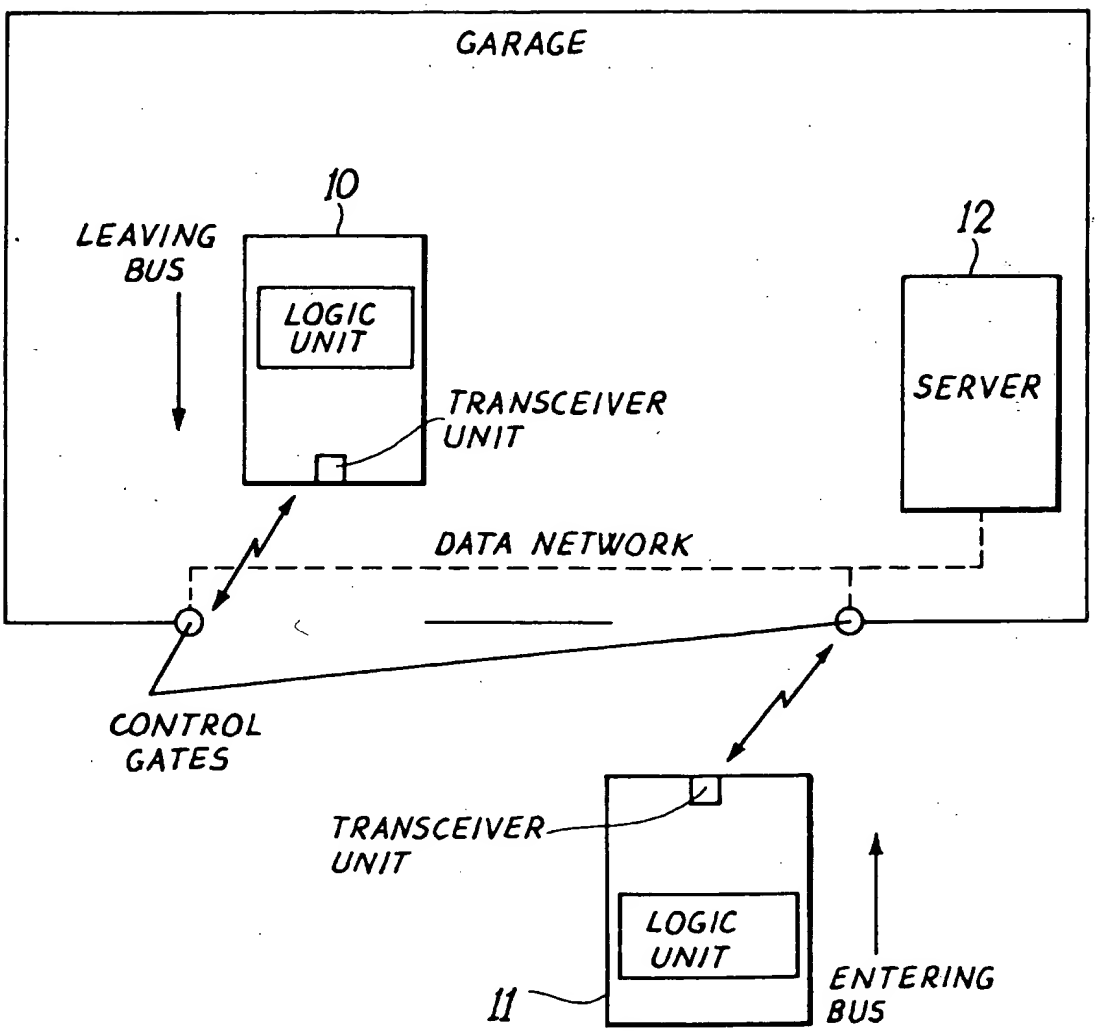

GARAGE
10
LEAVING BUS
LOGIC UNIT
TRANSCEIVER UNIT
12
SERVER
DATA NETWORK
CONTROL GATES
TRANSCEIVER UNIT
LOGIC UNIT
11
ENTERING BUS

FIG. 1

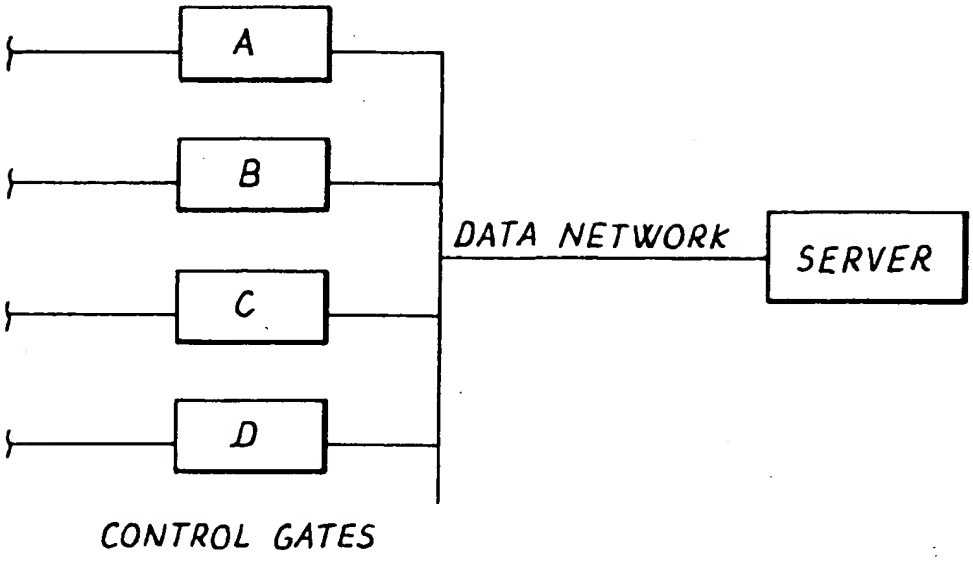
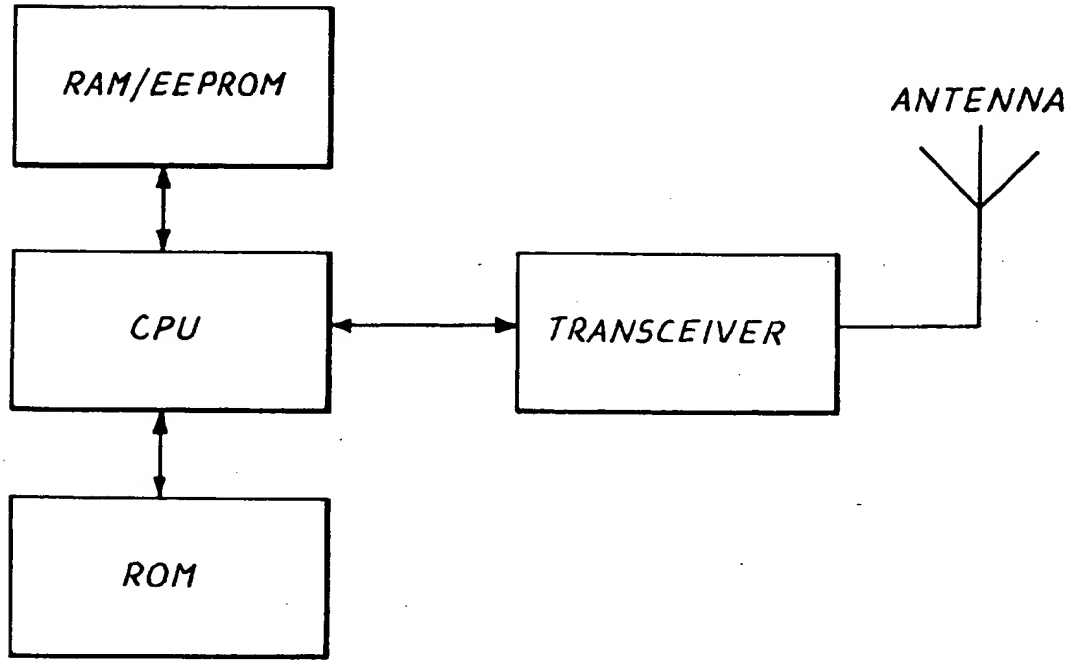

A
B
C
D
DATA NETWORK
SERVER
CONTROL GATES

FIG. 2

FIG. 4


RAM/EEPROM
ANTENNA
CPU
TRANSCEIVER
ROM

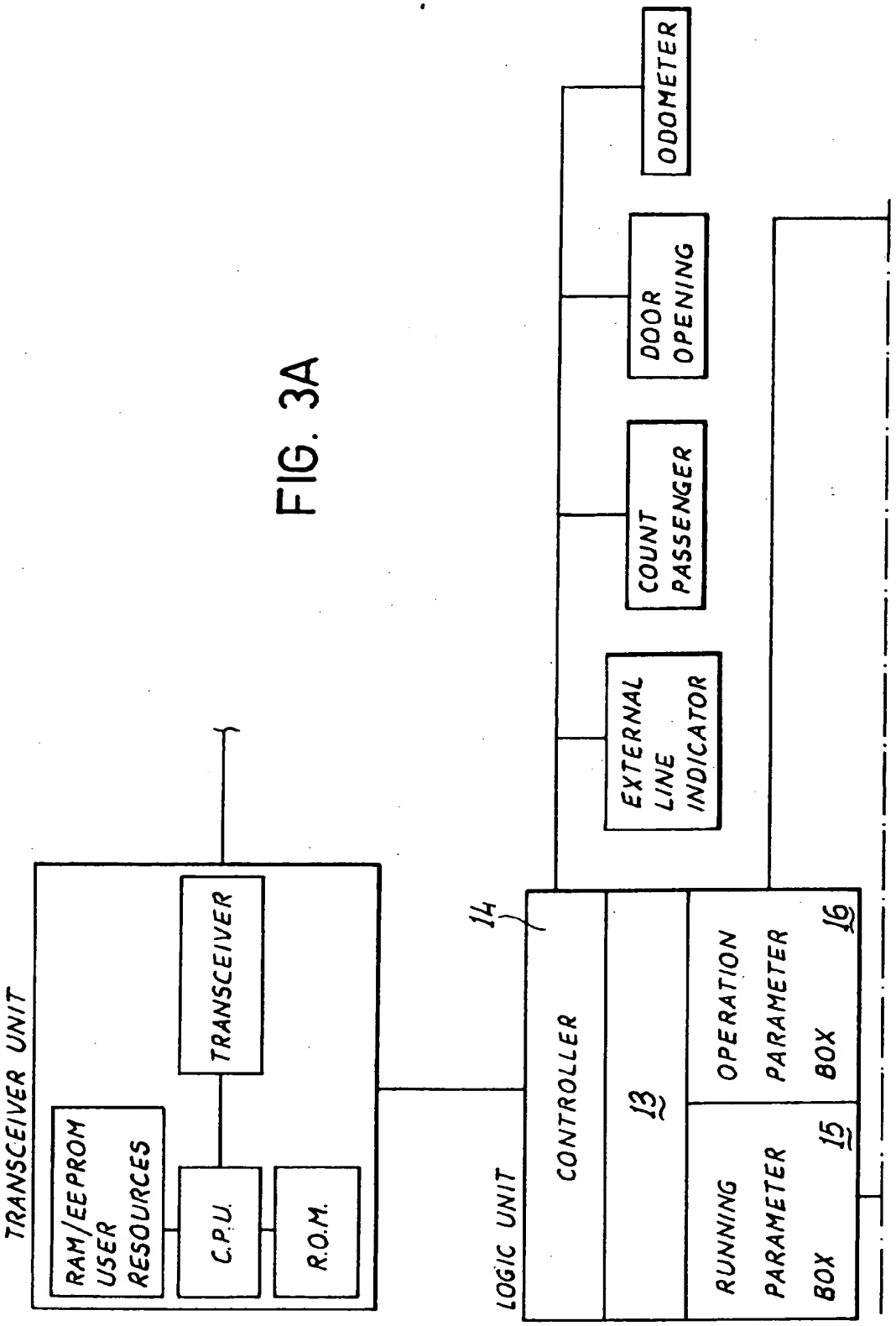

TRANSCEIVER UNIT
RAM/EEPROM USER RESOURCES
C.P.U.
R.O.M.
TRANSCEIVER
LOGIC UNIT
14
CONTROLLER
13
OPERATION PARAMETER BOX
16
RUNNING PARAMETER BOX
15
EXTERNAL LINE INDICATOR
COUNT PASSENGER
DOOR OPENING
ODOMETER

FIG. 3A

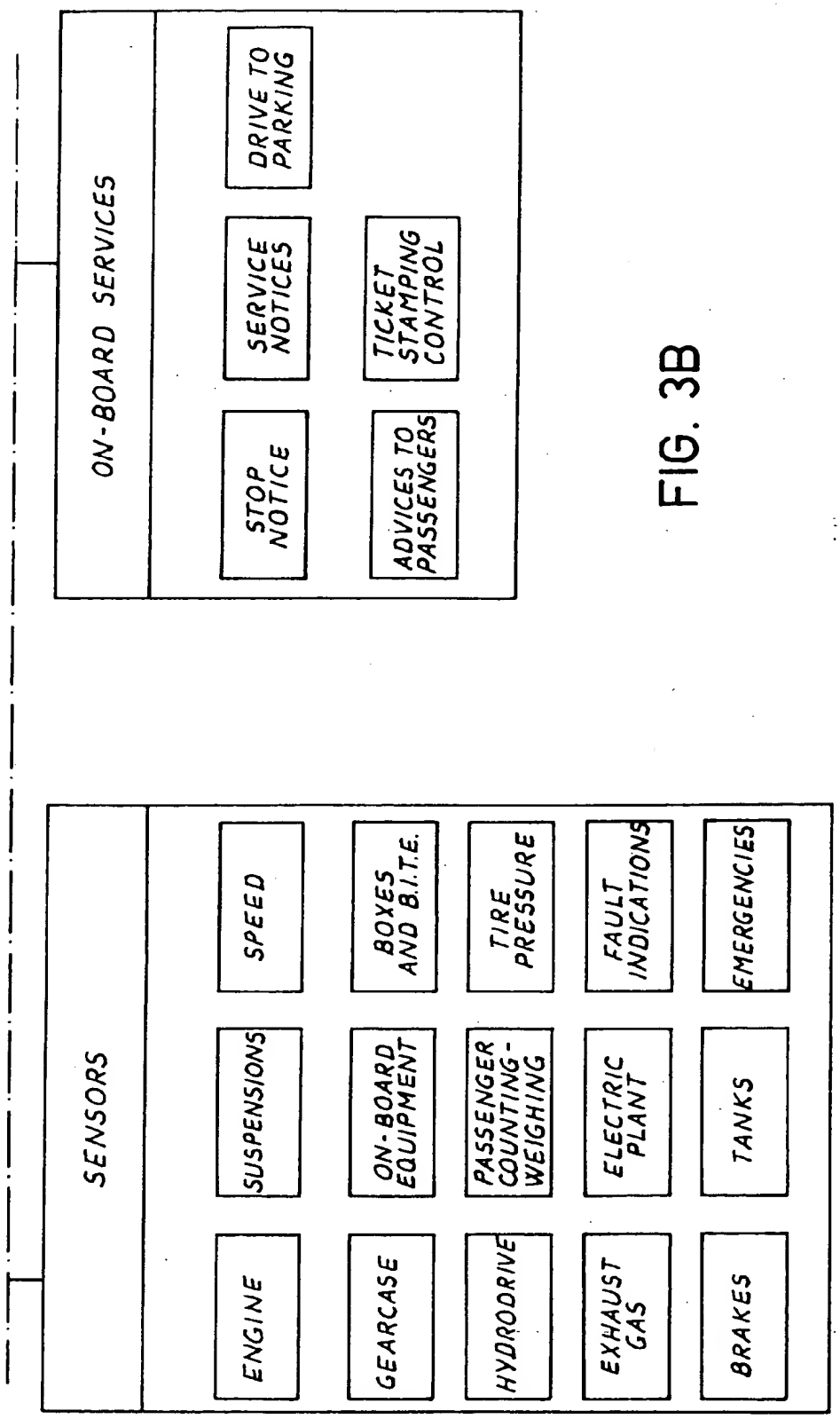

SENSORS
ENGINE
SUSPENSIONS
SPEED
GEARCASE
ON-BOARD EQUIPMENT
BOXES AND B.I.T.E.
HYDRODRIVE
PASSENGER COUNTING-WEIGHING
TIRE PRESSURE
EXHAUST GAS
ELECTRIC PLANT
FAULT INDICATIONS
BRAKES
TANKS
EMERGENCIES
ON-BOARD SERVICES
STOP NOTICE
SERVICE NOTICES
DRIVE TO PARKING
ADVICES TO PASSENGERS
TICKET STAMPING CONTROL

FIG. 3B

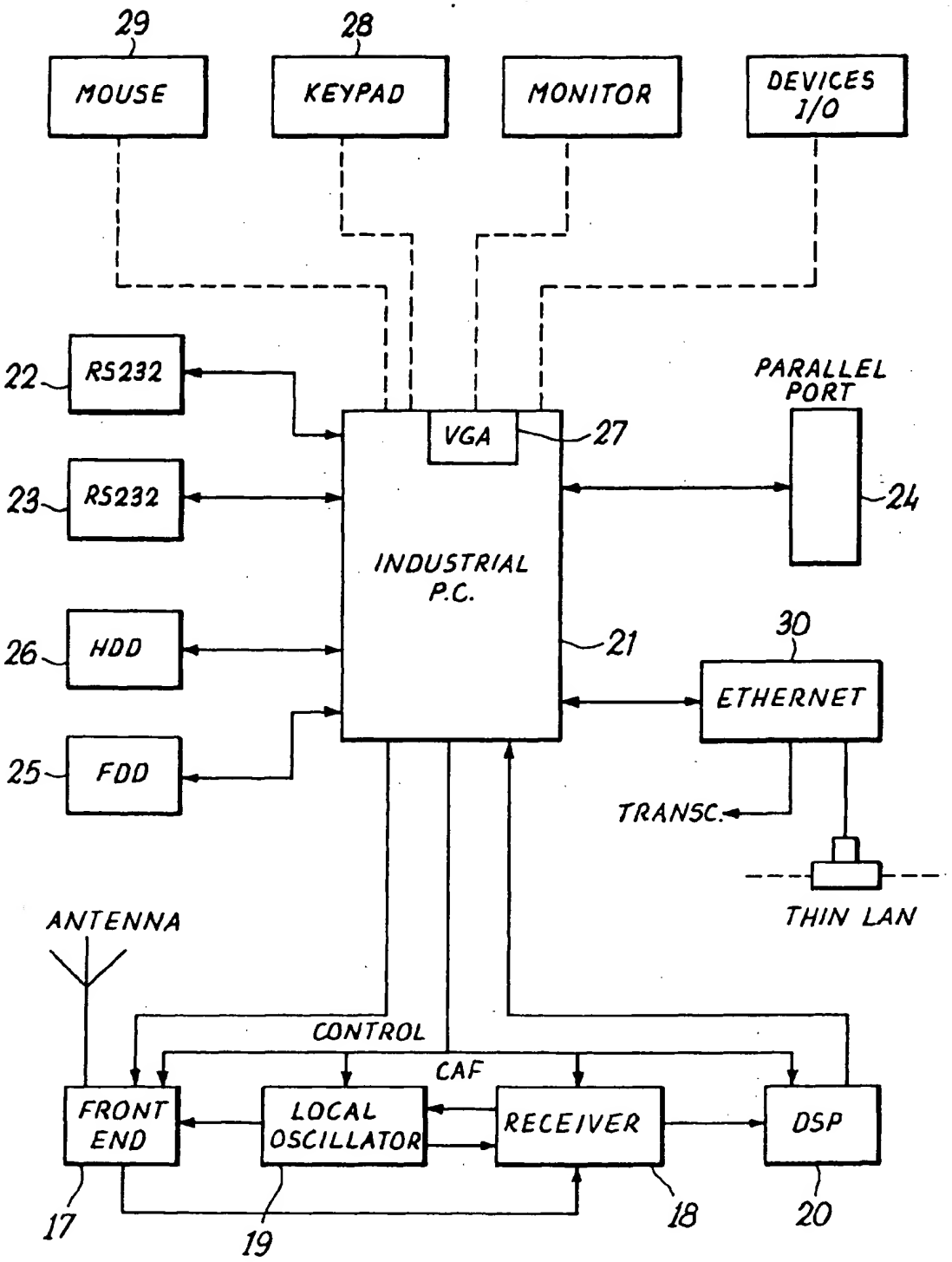

29
28
MOUSE
KEYPAD
MONITOR
DEVICES I/O
22
RS232
23
RS232
VGA
27
PARALLEL PORT
24
INDUSTRIAL P.C.
21
26
HDD
25
FDD
30
ETHERNET
TRANSC.
THIN LAN
ANTENNA
CONTROL
CAF
FRONT END
LOCAL OSCILLATOR
RECEIVER
DSP
17
19
18
20

FIG. 5